13. A method according to Claim 12, further comprising correcting the sensitivity of the first photodetector relative to an illuminance on a plane corresponding to a surface of the photosensitive object corresponding to the change of transmittance.

REMARKS

Claims 1-13 are now presented for examination. Claims 1, 2, 4 and 6-12 have been amended to define still more clearly what Applicants regard as their invention, in terms which distinguish over the art of record. Claims 1, 8 and 12 are the only independent claims.

Claims 4 and 10 have been rejected under 35 U.S.C. § 112, second paragraph, as indefinite in that it is not understood how the processing system can determine the change in transmittance the detection result of said first photodetector information regarding transmittance of the original since the first photosensor monitors light projected to the wafer and cannot detect information regarding transmittance of the original.

Claim 4 as amended recites that the processing system changes the proportional coefficient on the basis of at least one of information regarding an illumination extent of said illumination optical system, information regarding transmittance of the original, and a detection result of said first photodetector. As amended, Claim 4 clarifies that the detection result of the first detector (disposed in a portion for receiving light from an optical path between said light source and a portion where the original is placed) is used to change the proportional coefficient and that information regarding transmittance of the original can also be used. Claim 10 has been similarly amended. Accordingly, it is

believed that Claims 4 and 10 as amended fully meet the requirements of 35 U.S.C. § 112, second paragraph.

Claims 1-5 and 7-13 have been rejected under 35 U.S.C. § 102(b) as anticipated by U.S. Patent 5,892,573 (Takahashi et al. '573). Claim 6 has been rejected under 35 U.S.C. § 103(a) as unpatentable over Takahashi et al. '573. With regard to the claims as amended, these rejections are respectfully traversed.

Independent Claim 1 as amended is directed to exposure apparatus in which an illumination optical system illuminates an original on which a pattern is formed by exposure light emitted from a light source. A projection optical system projects the pattern to a photosensitive object. A first photodetector is disposed in a portion that receives light from an optical path between the light source and the portion where the original is placed. The first photodetector is used to monitor the emission light amount from the light source. A processor system changes the proportional coefficient of a target value of the first photodetector output and a voltage applied to the light source according to the change of transmittance of at least one optical element between the light source and the first photodetector.

Independent Claim 8 as amended is directed to a method of producing devices using an exposure apparatus. According to the method, an illumination optical system illuminates an original on which a pattern is formed by exposure light from a light source. A projection optical system projects the pattern to a photosensitive object and light is received by a first photodetector from an optical path between the light source and a portion where the original is placed. The first photodetector monitors the light source emission light amount. The proportional coefficient of a target value of the output of the

first light photodetector and the voltage applied to the light source are changed according to the change of transmittance of at least one optical element between the light source and the first photodetector. The photosensitive object is developed with a projected pattern to produce a circuit device. The illumination step is performed on the basis of the changed proportional coefficient for the first photodetector.

Independent Claim 12 as amended is directed to a method of exposing an original and projection a pattern formed on the original onto a photosensitive object. According to the method, the original is illuminated with an illumination optical system by exposure of light from a light source and the pattern of the original is projected onto the photosensitive object with a projection optical system. Light is received by a first photodetector from the optical path between the light source and a portion where the original is placed. The emission light amount from the light source is monitored by the first photodetector. The proportional coefficient of a target value of the first photodetector output and the voltage applied to the light source are changed according to the change of transmittance of at least an optical element between the light source and the first photodetector. The illumination is performed using the changed proportional coefficient for the first photodetector.

In Applicants' view, Takahashi et al. '573 discloses an exposure apparatus having an illumination optical system. A first light receiving system receives a portion of exposure light from the illumination optical system. A movable reticle stage has a transmitting portion that transmits exposure light and a second light receiving system receives the exposure light transmitted through the transmitting portion. The exposure

apparatus is able to correct the sensitivity of the first light receiving system without unloading a reticle.

According to the invention defined in Claims 1, 8 and 12 as amended, the proportional coefficient of a target value (i.e., light quantity which should be emitted from the light source for the appropriate exposure amount to a photosensitive object) of the output of a first photodetector that receives light from the optical path between a light source and the position of the original is changed and the voltage applied to the light source are changed according to a change in transmittance of at least one optical element between the light source and the first photodetector.

Takahashi et al. '573 may teach correcting for the sensitivity of a first light quantity detector (i.e., that receives light from an optical path between a light source and an original) based on a change of transmittance of an optical element between the first light detector and a second light quantity detector located at a wafer position. As required in Takahashi et al. '573, a first ratio is detected between detected values of the first and second light quantity detectors in a state in which the reticle is not disposed on the path of exposure light. A second ratio between detected values of the first and second light quantity detectors in a state in which the reticle is disposed in the path of exposure light and a third ratio between detected values of the first and second light quantity detectors in a state, after at least one exposure process. The reticle is disposed in the path of exposure light and the sensitivity of the first light quantity detector is corrected on the basis of the first, second and third ratios.

Takahashi et al. '573, however, fails in any manner to disclose or suggest anything about changes in transmittance of optical elements between a light source and a

first light quantity detector and Takahashi et al.'s first, second and third ratios are directed away from and fail to suggest the feature of changing the proportional coefficient of a first photodetector output according to a change in transmittance of at least one optical element between a light source and the first photodetector as in Claims 1, 8 and 12. Accordingly, it is believed that Claims 1, 8 and 12 as amended are completely distinguished from Takahashi et al. '573 and are allowable thereover.

Claims 1, 2, 4, 5 and 7-13 have been rejected under 35 U.S.C. § 102(b) as anticipated by U.S. Patent 5,861,944 (Nishi '944). Claims 3 and 6 have been rejected under 35 U.S.C. § 103(a) as unpatentable Nishi '944 in view of Takahashi et al. '573. With regard to the claims as amended, these rejections are respectfully traversed.

In Applicants' opinion, Nishi discloses scanning exposure apparatus that illuminates an area on a mask and has a power supply system to supply an exposure light source with electric power regulated to a predetermined state. An illumination intensity varying system provided between the exposure light source and the substrate regulates the attenuation rate of the illuminating light. An exposure amount measuring sensor measures the exposure energy of the illuminating light emitted from the exposure light source. A control system switches between a constant power mode supplying the exposure light source with a predetermined constant electric power through the power supply system and a constant illumination intensity mode that controls the function of the power supply system and the illumination intensity varying system in such a manner that the exposure energy measured by the exposure amount measuring sensor is maintained at a predetermined target value.

Nishi may disclose calibration of the sensitivity of an integrating sensor receiving light from a light source through optical elements. As disclosed at lines 38-63 of column 5 of Nishi, the sensitivity of exposure amount measuring means that monitors exposure amount on a substrate fluctuates among different exposure apparatus so that a fluctuation in the integrated exposure amount on the substrate results in case of exposure with different exposure apparatus. Nishi only provides an arrangement in which measurements are conducted with different illumination intensities and a conversion coefficient to the output signal of the reference illumination intensity meter is determined from each output signal of the exposure amount measuring means. The obtained plural conversion coefficients are memorized and an exact exposure amount common to the plural exposure apparatus is obtained by multiplying, in the signal correction means, the output signal of the exposure amount measuring means with thus memorized conversion coefficient.

Accordingly, Nishi only teaches a calibration for matching exposure amounts in plural exposure apparatuses but does not suggest in any manner changing the proportional coefficient of a target value of an output of a first photodetector (Nishi's sensor 11) and a voltage applied to said light source according to a change of transmittance of an optical element between the light source and the first photodetector as in Claims 1, 8 and 12. Further, Nishi adjusts exposure amount on a wafer surface by changing among different transmittance ND filters. It is not seen that changing the ND filters to adjust an exposure amount in any manner suggests the feature of Claims 1, 8 and 12 of changing a proportional coefficient of a first photodetector in response to a transmittance change of an optical element between a light source and the first photodetector. In at least the foregoing

respects, Claims 1, 8 and 12 as amended are completely distinguished from Nishi and are allowable.

A review of the other art of record has failed to reveal anything which, in Applicants' opinion, would remedy the deficiencies of the art discussed above, as references against the independent claims herein. Those claims are therefore believed patentable over the art of record.

The other claims in this application are each dependent from one or another of the independent claims discussed above and are therefore believed patentable for the same reasons. Since each dependent claim is also deemed to define an additional aspect of the invention, however, the individual consideration or reconsideration, as the case may be, of the patentability of each on its own merits is respectfully requested.

In view of the foregoing amendments and remarks, Applicants respectfully request favorable consideration and reconsideration and early passage to issue of the present application.

Applicants' attorney, Steven E. Warner, may be reached in our Washington, D.C. office by telephone at (202) 530-1010. All correspondence should continue to be directed to our below listed address.

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VERSION WITH MARKINGS TO SHOW CHANGES MADE TO THE CLAIMS

1. (Amended) An exposure apparatus, comprising:

a light source;

an illumination optical system illuminating an original on which a pattern is formed by the exposure light emitted from said light source;

a projection optical system projecting the pattern to a photosensitive object;

a first photodetector, disposed in a portion for receiving light from an optical path between said light source and a portion where the original is placed, said first photodetector being used for monitoring an emission light amount from said light source; and

[a processing system (i) obtaining information regarding light exposure provided to at least an optical element included in one of said illumination optical system and said projection optical system, (ii) estimating a change in transmittance of at least the optical element on the basis of the information obtained, ,and (iii) correcting a proportional coefficient for the light amount detected by said first photodetector and the emission light amount from said light source on the basis of the estimated change of transmittance]

a processor system changing a proportional coefficient of a target value of an output of said first photodetector and a voltage applied to said light source, in

accordance with a change of transmittance of at least an optical element between said light source and said first photodetector.

2. (Amended) An exposure apparatus according to Claim 1, wherein said processing system further performs sensitivity correction of said first photodetector relative to an illuminance on a plane corresponding to a surface of the photosensitive object on the basis of the [estimated] change of transmittance of at least an optical element between a position where light divided to said first photodetector and a photosensitive object.

4. (Amended) An exposure apparatus according to Claim 1, wherein said processing system [estimates the change in transmittance] changes said proportional coefficient on the basis of at least one of [a detection result of said first photodetector,] information regarding an illumination extent of said illumination optical system, [and] information regarding transmittance of the original, and a detection result of said first photodetector.

6. (Amended) An exposure apparatus according to Claim 1, wherein said light source has a pulsed laser, said illumination optical system has an ND filter and masking blades for determining an illumination extent, and said processing system [estimates changes in the transmittances of said illumination optical system and said projection optical system] changes said proportional coefficient on the basis of information

regarding output energy per pulse, an oscillation frequency and oscillation duty of said pulsed laser, a voltage applied to said pulsed laser, a transmittance of said ND filter and the original, and the illumination extent formed by said masking blades.

7. (Amended) An apparatus according to Claim 1, further comprising a second photodetector, disposed near the photosensitive object, having a light receiving surface positioned at the same height as a surface of the photosensitive object,

wherein said processing system further performs sensitivity corrections of said first photodetector and said second photodetector on the basis of the [estimated change] changes in transmittance of at least an optical element between the position where light divided to said first photodetector and said second photodetector.

8. (Amended) A method for producing devices by use of an exposure apparatus, said method comprising the steps of:

illuminating, with an illumination optical system, an original on which a pattern is formed by exposure light from a light source;

projecting, with a projection optical system, the pattern to a photosensitive object;

receiving light by a first photodetector from an optical path between the light source and a portion where the original is placed;

monitoring, by the first photodetector, an emission light amount from the light source;

[obtaining information regarding light exposure provided to at least an optical element included in one of the illumination optical system and the projection optical system;

estimating a change in transmittance of at least the optical element on the basis of the information obtained;

correcting a proportional coefficient for the light amount detected by the first photodetector and the emission light amount from the light source on the basis of the estimated change of transmittance;]

changing a proportional coefficient of a target value of an output of said first photodetector and a voltage applied to said light source, in accordance with a change of transmittance of at least an optical element between said light source and said first photodetector; and

developing the photosensitive object with a projected pattern, a circuit device being produced from the developed object,

wherein said illuminating step is performed on the basis of the [corrected] changed proportional coefficient for the first photodetector.

9. (Amended) A method according to claim 8, further comprising correcting the sensitivity of the first photodetector relative to an illuminance on a plane

corresponding to a surface of the photosensitive object on the basis of the [estimated] change of transmittance of at least on optical element between a position where light divided to said first photodetector and a photosensitive device.

10. (Amended) A method according to Claim 8, wherein said [estimating] proportional coefficient changing step is performed on the basis of at least one of [a detection result of the first photodetector,] information regarding an illumination extent of the illumination optical system, [and] information regarding transmittance of the original, and a detection result of the first photodetector.

11. (Amended) A method according to Claim 8, wherein said [estimating] proportional coefficient changing step is performed on the basis of monitoring results of the change of a ratio of an output of the first photodetector to a voltage applied to the light source.

12. (Amended) A method for exposing an original and for projecting a pattern formed on the original onto a photosensitive object, said method comprising the steps of:

illuminating, with an illumination optical system, the original by exposure light from a light source;

projecting, with a projection optical system, the pattern of the original onto the photosensitive object;

receiving light by a first photodetector from an optical path between the light source and a portion where the original is placed;

monitoring, by the first photodetector, an emission light amount from the light source;

[obtaining information regarding light exposure provided to at least an optical element included in one of the illumination optical system and the projection optical system; and

correcting a proportional coefficient for the light amount detected by the first photodetector and the emission light amount from the light source on the basis of a change in transmittance;]

changing a proportional coefficient of a target value of an output of said first photodetector and a voltage applied to the light source, in accordance with the change of transmittance of at least an optical element between said light source and said first photodetector;

wherein said illumination step is performed by using the [corrected] changed proportional coefficient for the first photodetector.